PROFESSIONAL DEVELOPMENT FOR GRADE TEN PHYSICAL SCIENCE TEACHERS.

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ABSTRACT – This paper reports on the findings of a study conducted in the Umlazi District in the Kwa-Zulu Natal province in South Africa. The study involved three Physical Science teachers who were in possession of a professional qualification. The focus was on the nature of the professional development that was received by the grade ten Physical Science teachers. Due to the nature of this study being descriptive and exploratory, a qualitative case research design was adopted. To ensure trustworthiness of the data, participants responded to open ended questionnaires and were interviewed. The study aimed at answering the following research question: What is that nature of the professional development received by grade ten Physical Science teachers? The findings of the study indicated that there is no professional development workshops that focus on grade ten Physical Sciences. The findings further indicated focus areas for developmental workshops for the improvement of grade ten Physical Science teacher classroom practices, these were content knowledge, pedagogical approaches for a South African classroom and teacher practical training programmes.

Keywords: Professional development, Science, classroom practices

INTRODUCTION

Over the years learner performance in Physical Sciences in most South African schools has been reportedly poor according to various stakeholders. One critical contributory factor to this poor performance in the subject has been identified as the lack of understanding of basic concepts amongst Physical Science learners despite the fact that these concepts are introduced as early as grade ten (DBE, 2016). This study focuses on grade ten Physical Science teachers because the NSC Diagnostic reports of 2016, 2015 and 2014, revealed that the majority of Physical Science learners lacked proper knowledge on practical work as well as knowledge on scientific method and basic science concepts that are taught in grade 10. This study therefore chose to focus on the professional development of grade ten physical science teachers and the influence it has on the implementation of the grade 10 Physical Sciences curriculum in South African schools. The conceptual framework used for the study was concerned with understanding teacher's classroom practices, within a social context (the school), from the teacher's perspective. The ontology of the study is that teacher realities are socially constructed. The epistemology is interactive because the understanding of parts (professional development and content knowledge) leads to an interpretation of the whole (teacher's classroom practices) and the whole leads to an interpretation of the teachers' professional development and content knowledge.

LITERATURE REVIEW

Professional development within the context of education refers to the professional growth a teacher achieves as a result of gaining further experience and examining his/her teaching systematically (Villegas-Remers, 2003). This can be achieved through formal experiences (e.g. attending workshops and professional mentoring) and informal experiences (e.g. observations of colleagues teaching) (Villegas-Remers, 2003). "Professional development is considered an essential mechanism for deepening teachers' content knowledge and developing their teaching practices" (Desimone, Porter, Garet, Yoon, & Birman, 2002, p. 81). For the teachers to be knowledgeable there has to be a continuous sustainable comprehensive developmental programmes in place to enhance teacher knowledge (Kriek & Grayson, 2009). Dass (1999), states that to have the developmental needs of teachers addressed adequately the single "one-shot" approach is an inappropriate and will fail. In addition studies by Fennema and Franke (1992), have suggested that the content knowledge of the teacher does influence the classroom practice. When new content is introduced in the syllabi, it creates a greater burden on the teacher (Bennie & Newstead, 1999). This is due to unfamiliarity with the content the teacher is unable to highlight certain important factors on the new content. Thus teacher development becomes critical for successful implementation of educational change. Similarly, when there is deficit of content knowledge, then there is a need for professional development programmes to be

executed (Ramnarain, 2013). The tailoring of such programmes should be around the needs of teachers. This is clearly expressed in the National Strategy for Mathematics, Science and Technology (DoE, 2001) whereby it states the need for higher education institutions to develop rigorous, high quality and relevant training programmes for teachers that will assist in strengthening both subject matter expertise and pedagogical content knowledge. However the needs of grade specific teachers must also be addressed as in this case the grade ten Physical Science teachers.

Loucks-Horsley, Hewson, Mundry, and Stiles (2009) cite several principles for effective professional development in Physical Science which they mention as, learning Physical Science content through inquiry; building understanding as a lifelong learner; and professional development opportunities that are consistent and integrate. In South Africa, professional development of teachers was often referred to as in-service education or staff development (Ono & Ferreira, 2010). Currently, some researchers have argued that the "traditional professional development workshops" (in the forms of seminars, conferences or courses and workshops) that the South African government spends millions of South African Rands on are fragmented, de-contextualized, incoherent and very isolated from the real classroom practice situations. Kelleher (2003, p. 751), refers to these traditional development workshops as "adult pull-out programmes" and is of the view that it is highly unlikely for these workshops to result in improvement of teacher classroom practice activities.

According to Supovitz and Turner (2000), professional development is still considered the best option for the reform of classroom practices of teachers due to the fact that many other alternate methods have also fared no better. For effective science professional development, researchers and teachers have come to the consensus that developmental programmes model inquiry forms of teaching(Supovitz & Turner, 2000). The advantage using programmes that model scientific reasons is that is has a greater influence on learner achievement, as compared to programmes that placed emphasis on teaching teachers to use a specific curricular (Marek & Methven, 1991).

Supovitz and Turner (2000) further state that professional development for science teachers must be intensive and engaging. It must also involve authentic tasks that are based on the experiences that teachers have with their learners. Professional development of teachers must also focus on the grade ten subject matter content and improving the teacher's content skills respectively. Professional development of Science teachers also involves, professional development standards that show teachers how to take the knowledge gained through a workshop and connect their work to the standards of student performance for example, dealing with problem solving skills which requires teaching strategies that set higher learning goals (Supovitz and Turner, 2000). Thus when the time spent on professional development is increased, then the teachers use of inquiry based teaching practices increases and teachers establish and display higher levels of investigative classroom culture (Supovitz and Turner, 2000) This therefore informs improved classroom instruction that promote meaningful learning in a grade ten classroom.

Conceptual Framework

For this study, teacher profession development is defined as the continuous process of equipping both experienced and novice teachers with the necessary and applicable knowledge and skills required to effectively and efficiently deliver a successful grade 10 Physical Sciences curriculum in a South African classroom. The conceptual framework used for the study is based on Supovitz and Turner (2000), proposed aspects that are essential for effective professional development. Professional development directly impacts on n teacher classroom practices and teacher content knowledge. The teacher's content knowledge and in turn also shapes the teacher's classroom practices (Desimone et al. 2002).

METHODOLOGY

Due to the nature of the study being descriptive and explanatory, a qualitative case research design was adopted, as it allowed the researcher to explore in-depth experiences of teachers in the teaching of Physical Sciences in grade 10 classrooms. The study focused on three permanently employed teachers. Selected participants had to be in possession of a recognized formal teaching qualification and give consent to the study. This study was undertaken in the

Republic of South Africa (RSA) in the province of Kwa-Zulu Natal. Questionnaires and semi-structured interviews were used for data collection. Data was analyzed using the typology approach. To ensure rigor, all data collection instruments were piloted. Ethical considerations were accounted for in this study.

RESULTS & DISCUSSION

Teacher X

Teacher X has been teaching for just over 5 years. She has a Bachelor of Science degree and a Post Graduate Certificate in Education.

Researcher: How often did you attend professional development workshops?" "*For grade ten there is nothing".* Although Teacher X was teaching for several years she felt she still required development in the curriculum. This was evident from her response below, "*Not really, some practical's I still do not do because I don't know how to. I don't feel safe using the chemicals. Some sections like stoichiometry I have to read and understand first because the math is a bit difficult."* Teacher X indicated that she struggled at times with the Mathematics that was involved in Physical Sciences although she was well versed in some topics of the curriculum. When professional development focuses on subject-matter knowledge and deepen teachers' content skills (Cohen & Hill, 1998), it then allows for teacher knowledge and skills to be enhanced (Guskey, 2009). "*Having workshops that teach us a teachers how to conduct experiments, what common errors to look out for, can make my lessons so much more interesting. And if I can capture the attention of my learners I am sure issues of discipline can be eliminated, learner performance would possible improve. Such workshops will really just improve my content knowledge and skills as a teacher and I strongly feel it would even improve the way I teach."* Teacher X, felt that professional development in terms of experiments were essential i.e. Teacher Practical Training Programmes (TPTP). It would not only improve her knowledge but also her teaching as Duncal et al. (2007) explains professional development not only impacts on teacher knowledge but also results in improved classroom teaching which links itself to an increase in learner achievement. Teacher X, did not use the inquiry approach to teach. "*Endothermic and exothermic reactions I use the data projector to show the burning of magnesium ribbon because I was never workshopped on doing the practical and I am not sure how to do it myself and I have to put the learner safety first*." The lack of knowledge on how to conduct experiment's not only impacted on Teacher X's teaching but also demotivated her at times, and this was evident in her questionnaire response, "*It is embarrassing to be unable to answer questions that your learners ask you when conducting a practical, like the how, why and what happens".* " *We don't have grade ten prac workshops...my pracs are more investigative I give the learners a set of results and ask them to interpret it".* Thus based on the responses of Teacher X, it can be deduced her practical lessons, are in fact a theory lesson because the learners are not physically engaged in doing an experiment, they are merely interpreting results. Teacher X was very keen on attending professional development workshops because she was of the belief that it would improve not only her content knowledge but also her classroom instruction. Because high quality professional development are structured in a manner that immerses the teachers in inquiry, questioning, and experimentation and therefore models inquiry forms of teaching (Supovitz & Turner, 2000).

Teacher Y

Teacher Y had been teaching for well over a decade. Her qualifications include a junior secondary education diploma, a Bachelor of Education degree with majors relating to Natural Sciences and Physical Sciences.

Teacher Y believed professional development was about the, *"Development of educators to perform better in class."* In her questionnaire she explained professional development as, *"Attending workshops that make us aware of better and easier approaches to teaching the topics, and make us aware of what the current field is looking at."* During interviews teacher Y alluded to professional development that would help improve her methods of approaching a topic and introducing the content to the learners, i.e. her PCK would be improved. Therefore professional development should be used as a mechanism for deepening teachers' content knowledge and

developing their teaching practices (Desimone et al., 2002). Information gained from the Diagnostic Reports and should be used as a guideline for grade 10 as grade 10 creates the foundation for grade eleven and ultimately grade twelve. The teacher's responses and views toward professional development concurred with the works of Avalos (2011), who stated that professional development for teachers is about teachers becoming learners, learning how to learn and finally cascading this knowledge to learners in their classrooms through classroom practice. Teacher Y indicated that she did engage in professional development, however none of the programmes focused on the grade 10 Physical Science content, *"Emphasis is on grade twelve work".* It is grade 10 that lays the foundation for Physical Sciences therefore it is essential that teachers teaching grade ten are proficient in their subject matter knowledge as well as methodological approaches to teaching Physical Sciences (Anthony and Walshaw 2009; Drake, Spillane, and Hufferd-Ackles, 2001; Jita and Ndlalane, 2009; Zakaria and Daud 2009). Teacher Y felt that practical workshops i.e. workshops that actually involved the teachers physically conducting experiments would in fact enhance her teaching, *"Yes, yes it would really."* She then went on further to say, *"I may be doing the practical and it maybe not a hundred percent correct or I could be doing it incorrectly." "It would definitely help to have a practicals workshop that will explain the practical and how to conduct it, provide the teachers with guidelines on how to do the practicals and the CASS pieces and how to prepare learners for the exams."* When Teacher Y was questioned on the frequency of conducting experiments in class, she alluded to the availability resources as a determinant. However, the teacher's comment "*practical workshop that will explain the practical and how to conduct it"* suggests that although Teacher Y was competent in terms of theoretical aspects, her ability to execute it practically was a problem. Having no professional development workshops that focused on the development of practical skills in teachers created room of uncertainty in Teacher Y. Ramnarain (2013), states that professional development programmes must be tailored according to the needs of teachers, and from Teacher Y's response, the development of practical skills in teachers irrespective of years of experience is essential. Teacher Y envisaged professional development that equipped teachers with the knowledge and approaches to answering higher order questions; explanatory and practical workshops for prescribed experiments; workshops that developed teachers' content and varying approaches to delivering the content. Badasie (2014), states that to achieve such outcomes collaboration is required amongst colleagues therefore professional development is conceived as a socially negotiated activity.

Teacher Z

Teacher Z had been teaching Physical Sciences for over two decades. Teacher Z indicated that there was no grade 10 Physical Sciences workshops. "t*he workshop focus is grade twelve, there is no workshop in term four".*

Teacher Z's understanding of professional development was as follows, *"I) being efficient in all aspects of teaching" , and II) coming to terms with the mandate that is given to you by the subject advisor, they set down guidelines to follow given by the department and the teacher must follow it and live up to it."* Examining statement (I) above of Teacher Z, he was aware that to be a teacher in the South African classroom development was required along three dimensions simultaneously: content knowledge, teaching approaches and professional attitudes (Kriek and Grayson 2009). Teacher Z's statement (II) indicated that he understood professional development as teachers' acknowledging the policy documents which clearly indicated what was required to be taught, assessments to be completed and the timeline for which it was to completed in. The Curriculum and Assessment Policy Statement for Physical Sciences states that Physical Sciences is a subject that "promotes knowledge and skills in scientific inquiry and problem solving; the construction and application of scientific and technological knowledge; an understanding of the nature of science and its relationships" (DBE, 2011, p. 8). Avalos (2011), was of the view that professional development for teachers must encompasses teacher learning, learning how to learn and transforming their knowledge into practice for the benefit of the growth of their learners, and not only necessitate teacher understanding of policy documents.

In Teacher Z's questionnaire responses he indicated that professional development also entailed,

"III) Interaction with colleagues also is part of professional development." "IV) They are important because certain standards have been set and the teacher has to make those standards. Practice makes perfect". Teacher Z's understanding of professional development also included interaction with other Physical Science teachers. Such interaction would have allowed for these teacher's to share pedagogies appropriate for teaching grade 10 Physical Sciences. Although the teacher had attended workshops, its focus was grade twelve. The pedagogies that a teacher may use to teach grade twelve mechanics would differ from that the teacher would use to teach grade 10 mechanics for the simple reason that the cognitive developmental levels of learners in the two grades differ. Teacher Z had many years of experience and excellent subject matter knowledge as a teacher; but in in order for him to have been able to engage his learners in collaborative discussions to communicate scientific ideas, he required the chance to participate in professional learning thus allowing him the opportunity to learn different pedagogies appropriate for teaching Physical Sciences at the grade 10 level (Duschl and Gitomer, 1991). He would have liked professional development programmes to be structured based on the National Diagnostic Reports of examiners for the National papers that are written at the end of each academic year, *"Look at the examiner's report and look at what the problems are and deal with the identified issues. Print material for teachers to improve their content knowledge."* The teacher felt this was essential because teachers' content knowledge and conceptual understanding of the subject has to be good in order to develop the learners' conceptual understanding of Physical Sciences. Borko (2004), states that teachers must have rich and flexible knowledge of the subject. Teacher Z also was of the view that professional development programmes must make teachers' aware of the common errors that learners in a South African classroom are prone to making in Physical Sciences. From Teacher Z responses the professional development that he did attend thus far was in fact not catering for his needs as a teacher, *"(Researcher) Do the workshops train you in terms of practicals?" "No. The workshops do not physically do the practicals. Since 2007 there was only one occasion where practical work was actually done at a workshop." "The disadvantage I find these days is some of the equipment for practicals is so advanced even I don't know how to use it, yet I am an experienced teacher."* The professional development workshops that Teacher Z attended firstly did not meet his needs as a teacher. Kwok (2014) states that for professional development programmes to be effective is must address the concerns and needs of teachers. Secondly, Teacher Z indicated that he had found difficulty in the use of practical equipment, particularly new modern equipment.

CONCLUSION

In answering the research question, "What is the nature of professional development received grade 10 Physical Sciences teachers?" it is none. From the data collected all three teachers indicated that there was no professional development that focused on grade ten Physical Sciences. The findings of the study further indicated that for the improvement of teacher classroom practices, professional development for Physical Science teachers should focus on the needs of teachers. From the interviews with the three teachers, common areas that require development were identified. These included content knowledge, pedagogical approaches for a South African classroom and teacher practical training programmes (Desimone et. al 2002; Gillies & Nichols, 2015; and Ramnarain, 2013). Thus linking the findings to the conceptual framework, professional development can be considered as a critical component for effective classroom practices. Professional development can, implicitly influence a teacher's classroom practice through the improvement of teacher content knowledge thereby giving teachers a greater degree of confidence when teaching, and explicitly influence a teacher's classroom practices through the development of teachers PCK and teacher practical training programmes.

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